SUMMARY

Radian Corporation, a Dallas-based scientific research and consulting firm, supports the allocation of spectrum for Wind Profiler Radar Systems ("Wind Profilers") at both 449 and 915 MHz. Wind Profilers, an outgrowth of Doppler radar studies of the ionosphere, have many beneficial uses, the most significant of which appear to be weather forecasting and environmental assessment.

Both allocations are necessary because low frequency Wind Profilers and high frequency Wind Profilers have different capabilities and serve different, but important, functions. Low frequency Wind Profilers examine the troposphere, mostly for weather-related measurements. They operate at high power levels with large antennas. High frequency systems, which operate at much lower power levels, are useful for lower atmosphere profiles which low frequency profilers cannot measure. Lower atmosphere studies are most useful in the environmental studies necessary to address current pervasive air-quality problems.

It is unlikely that 915 MHz Wind Profilers will interfere with other users of the band. 915 MHz Wind Profilers have been operated across the nation, often in urban and populated areas where ISM devices, Amateur Radio operators, and developmental AVMS systems sharing the band are likely to be operating. 915 MHz Wind Profilers have an outstanding record of non-interference to other band users. This is due to the low power levels, side lobe suppression fences, and other operational characteristics of 915 MHz Wind Profilers.

915 MHz Wind Profilers are fully developed and ready for commercial implementation. Governed by the rules Radian has proposed, 915 MHz Wind Profilers can operate to the benefit of all, with little or no inconvenience to users sharing the band. Finally, 915 MHz Wind Profilers require 12.5 MHz in bandwidth because of the characteristics of the pulses and the required range resolution.

Before The

Federal Communications Commission

Washington, D.C. 20554

In The Matter Of

of lower-atmosphere Wind Profilers. The Commission issued Public Notice of Radian's petition on October 1, 1992 (Report No. 1909 (Oct. 1, 1992)), requesting comments.[1]

The Commission chose to address both allocation requests in a single proceeding and released the above-referenced Notice of Proposed Rule Making and Notice of Inquiry ("NPRM/NOI") on April 1, 1993 (FCC Document 93-136), setting the deadline for comments at June 15, 1993, and reply comments at July 15, 1993.

B. The Development of Wind Profilers

Wind Profilers developed as an outgrowth of Doppler radar studies of the ionosphere in the late sixties and early seventies (Petition, Appendix A at 6). Wind, temperature, pressure, humidity and other environmental phenomena create refractive irregularities in the atmosphere which "scatter" RF electromagnetic pulses sent from the ground. Receiving equipment records scattered energy returned to earth, which can then be analyzed (*id.* at 7), providing highly accurate meteorological data on a real-time basis.

As described in Radian's Petition, the basic components of a Wind Profiler include a transmitter, antenna array, receiver and processor (*id.* at 19). The antenna array emits pulsed signals vertically in three or five narrow beams, with one beam at zenith and the remaining

[1]EnScan, Inc. ("EnScan") and Telxon Corporation ("Telxon") filed formal oppositions to Radian's Petition, and the American Radio Relay League, Inc. ("ARRL") and AMTECH Corporation ("AMTECH") filed comments. On December 17, 1992, Radian filed its Reply Comments and Amended Petition for Rule Making ("Radian Reply"), and on December 18, 1992 filed an Erratum to its Reply Comments and Amended Petition for Rule Making ("Radian Erratum"). Hughes Aircraft Company also filed reply comments on December 18, 1992.

beams at 15°-20° from zenith (Petition at 3). Wind Profilers operating at lower frequencies (i.e., 449 MHz), provide profiles of upper-altitude conditions; conversely, high frequency profilers (such as Radian's LAP™-3000 Lower Atmosphere Profiler operating at 915 MHz) are primarily

II. RADIAN SUPPORTS ALLOCATION OF SPECTRUM FOR WIND PROFILER RADAR SYSTEMS

For the reasons set forth herein, and such further reasons as are described in its Petition and Reply Comments, Radian supports the allocation of spectrum for Wind Profilers in *both* the 449 MHz and 908.75-921.25 MHz bands. The many beneficial meteorological, environmental, scientific and safety-related uses for Wind Profilers in each band amply justifies the allocation of both high and low frequency spectrum for government and non-government users, and far outweighs the minimal risk of interference to other users sharing the frequencies.

What the Commission must realize, however, is that merely allocating frequencies in the 449 MHz range will not satisfy the need for Wind Profilers. An allocation is necessary in two separate bands because of the markedly different uses of 449 MHz and 915 MHz Wind Profilers, as described more fully below. Radian's support of the NPRM should not, therefore, be interpreted as a justification for not allocating spectrum in the 915 MHz band.

III. ADDITIONAL SPECTRUM IS REQUIRED IN THE 900 MHz REGION OF THE BAND

A. 900 MHz and 400 MHz Wind Profilers Perform Distinct Functions

Wind Profilers operating at 449 MHz are ideal for National Weather Service applications and other uses requiring measurements of the troposphere. (Supplemental Engineering Statement of John Neuschaefer, attached hereto as Exhibit 1). 915 MHz systems cannot

perform these tropospheric monitoring functions. Conversely, 449 MHz systems cannot measure the boundary layer of the atmosphere at the same degree of resolution as can 915 MHz systems, which is essential to most air-quality and environmental research projects such as the Lake Michigan Ozone Study, for which Radian provided 915 MHz Wind Profilers under experimental authorizations (*id.* at 2; Petition at 2 and Appendix D).

As set forth in its December 17, 1992 Reply Comments, Radian is experiencing an ever-increasing demand for its high-frequency environmental Wind Profiling services from government environmental authorities, including the U.S. Environmental Protection Agency, the Houston Regional Monitoring Corporation, the Texas Air Control Board, the South Coast Air Quality Management District, and many private entities and educational institutions. Attached hereto as Exhibit 2 is a letter from the South Coast Air Quality Management District to the Commission, describing the usefulness of 915 MHz Wind Profilers in its mission. Also attached as Exhibit 3 is a letter to the Commission from the National Center of Atmospheric Research ("NCAR"), supporting Radian's Petition and describing its uses of 915 MHz Wind Profilers, and as Exhibit 4, a memorandum from Professor Dennis W. Thomson of the College of Earth and Mineral Sciences of Pennsylvania State University, describing the system's academic and research value.

Appendices D-G of Radian's original petition describe in detail several important environmental studies which utilized the 915 MHz Wind Profiler, including:

- The Lake Michigan Ozone Study (Petition, Appendix D);
- A study of the effect of the Salt River Project's Navaho Generating Station in Northern Arizona on visibility in the Grand Canyon (Petition, Appendices E, G);
- The San Joaquin Valley Air Quality Study (Appendices F, G);
- The 1990 Rural Ozone in the Southern Environment (ROSE I) study in Alabama (Petition, Appendix G); and
- Study of large-scale drainage winds for the Department of Energy along the Colorado Front Range (Petition, Appendix G).

Radian continues to receive orders for 915 MHz Wind Profilers at a rate exceeding one per month, virtually all of which are to be used in air-quality and atmospheric pollution studies (Exhibit 1 at 2).

Because lower-atmosphere readings require less transmitting power and a smaller antenna, high frequency Wind Profilers such as the LAP™-3000 system are cost-effective and have the added benefit of being transportable (*see* Petition, Appendix D at 3, Appendix E at 1, Appendix G at 1; Radian Reply, Appendix C, *passim*). Further, the environmental projects for which high-frequency Wind Profilers are so exclusively suited often require high precision and range resolution, which is a function of both frequency and, therefore, bandwidth (Exhibit 1, *passim*). The lower frequencies such as 449 MHz are simply too crowded to allocate more than two or at most four MHz (*id.*). As concluded by NOAA's National Environmental Satellite, Data, and Information Service, the 915 MHz band is the best place to locate lower-atmosphere Wind Profilers (Petition, Appendix I; Radian Reply, Appendix C).

B. The Environmental Functions of High-Frequency Lower Atmosphere Profilers Address Critical Needs

There can be no dispute that air pollution, acid rain, and increased ozone levels have created a pervasive health crisis which more than twenty years of efforts have been unable to bring under control. As described in the Senate Report regarding the 1990 amendments to the

Vice-President Gore has long recognized the paramount importance of cleaning and preserving the environment, and the pivotal role technology must play in the process. In his book *Earth in the Balance*, then-Senator Gore concluded that a comprehensive response to the environmental crisis would include "establishment of a comprehensive program for researching and monitoring the changes now under way in the environment . . ." Gore, *Earth in the Balance*, 306 (Plume, 1992). This would include, at an international level, "[t]he establishment of rigorous and sophisticated technology assessment procedures, paying close attention to all of the costs and benefits -- both monetary and ecological -- of . . . new proposed substitute technologies," (*id.* at 320). In short, technologies capable of *assessing* the impact of other technologies on the environments -- in just the way 915 MHz Wind Profilers were used to measure the effect of the Navaho Generating Station on visibility in the Grand Canyon, *supra*, are fundamental to future efforts to reverse the effects of toxic air pollution.

C. 900 MHz Wind Profiler Radar Systems Can Co-Exist with Existing and Planned Uses of This Band

1. Other Users of the 900 MHz Band

If granted an allocation, 915 MHz Wind Profilers will share spectrum with:

- Industrial, Scientific and Medical equipment, which are the designated primary users of the band pursuant to Part 18 of the Commission's Rules;
- The Amateur Radio Service, which uses the band on a secondary basis;

- Unlicensed Part 15 devices, which must accept interference from licensed devices and must cease operations causing interference to licensed devices, 47 C.F.R. §15.5(a); and

- If allocated pursuant to the Notice of Proposed Rule Making, PR Docket 93-61, released April 9, 1993 (FCC 92-141), Automatic Vehicle Monitoring Systems (or, if renamed as proposed by the Commission, Location and Monitoring Service).[2]

Radian proposes that Wind Profilers be licensed on a co-secondary basis to ISM equipment and, if appropriate, with AVMS systems. In the unlikely event that interference issues arise between Wind Profilers and AVMS systems or Amateur operators, such issues can be resolved by cooperation between the users involved.

2. 900 MHz Wind Profiler Systems Have A Ten-Year Record of Interference-Free Use

As Radian described in both its Petition and its Reply Comments, 915 MHz Wind Profilers have more than a ten-year record of interference-free operation,[3] in several cases at populated urban areas where ISM devices, Amateur Radio and even developmental AVMS systems were likely to be operating. For example, a 915 MHz Wind Profiler has been operated at Denver's Stapleton Airport since 1981 without a single report of interference (Radian Reply, Appendix A at 2). Similarly, Radian has received no complaints regarding the 915 MHz Wind Profiler it has operated at Los Angeles International Airport during 1992. (*Id.*) NOAA, one of Radian's partners in the CRDA and the first

[2] Comments in that proceeding are due June 29, 1993, and Radian intends to file comments further demonstrating that 915 MHz Wind Profilers and AVMS systems can co-exist in the 900 MHz band.

[3] As previously noted, the single reported instance of interference was caused by faulty installation, which was subsequently corrected (Radian Reply, Appendix A at 1).

developer of 915 MHz Wind Profilers, has enjoyed similar interference-free operating success (Radian Reply, Appendix C at 3). Accordingly, there is no practical or historical basis on which to conclude that an allocation for 915 MHz Wind Profilers will disrupt other users of the band in any way.

3. The Operational Characteristics of the 900 MHz Systems Minimize Interference Risk to Other Users

High frequency, lower atmosphere Wind Profilers have operating characteristics significantly different from 449 MHz Wind Profilers which make possible their coexistence with other users in the 900 MHz band.

For example, as described above, 915 MHz systems employ smaller antennas and operate at a significantly lower power level than do 449 MHz systems (Radian Reply, Appendix A at 4; Petition, Appendix A at A-6 - A-9). The systems' pulses are directed vertically and attenuated to the horizontal, which in combination with the side-lobe suppression fences employed by 915 MHz systems effectively minimize interference potential (Petition, Appendix A, *passim*). The system is designed for efficiency and operates accordingly. As pointed out in Radian's Reply, Appendix A (Erratum) at 2-4, allegations of theoretical interference raised by commenters have been based on 449 MHz operational parameters.

D. 900 MHz Wind Profiler Radar Systems Are Ready for Commercial Implementation

The 915 MHz Wind Profiler is a prime example of technology developed by the joint efforts of government and private industry. The new administration has expressed as one of its prime goals to "directly [support] the development, *commercialization and deployment* of new technology" (emphasis supplied), and to ensure that "agencies will make it a priority to remove obstacles to Cooperative R&D Agreements (CRADAs) and to facilitate industry-lab cooperation through other means." Clinton-Gore Policy Statement on "Technology for America's Economic Growth, A New Direction to Build Economic Strength (February 22, 1993), at 7, 9.

915 MHz Wind Profiler technology is fully developed and ready to be launched into the commercial market. The system's original specifications have been tested and refined through the joint efforts of NOAA, Radian and Sonoma Technology, Inc. over the past ten years. The burgeoning demand reflects both the sophistication and the critical need for the technology, and the confidence placed in the technology by the scientific community. Additionally, 915 MHz Wind Profiler technology will likely have a beneficial impact on the U.S. trade balance since Radian is developing substantial international business with its LAP™-3000 systems.

Governed by the specific rules proposed in Radian's Reply Comments and December 18, 1992 Erratum (incorporated herein by reference), 915 MHz Wind Profilers can be deployed and operated to the benefit of all, with little or no inconvenience to other users of the spectrum. Indeed, the proposed rules submitted by Radian in its

December, 1992, submissions are far more specific than those contained in the NPRM/NOI for 449 MHz Wind Profiler operation. The proposed new section 90.248 contains the current operating parameters for existing 915 MHz systems, including maximum peak power of 500 watts (100 watts average), use of side lobe suppression fences attenuating the horizontal lobe at least 45 dB, and requirements to investigate and eliminate harmful interference. These proposed technical rules are consistent with those found for other Part 90 devices.

E. Required Bandwidth

The NPRM/NOI seeks comment on the necessary occupied bandwidth for 915 MHz Wind Profilers. NPRM/NOI at ¶ 19. Because 915 MHz Wind Profilers are designed to take measurements having finer range resolution than 449 MHz Wind Profilers, 915 MHz Wind Profilers [redacted]

IV. CONCLUSION

For these reasons, and those set forth in Radian's Petition and Reply Comments, Radian respectfully requests that the Commission move with all diligence to allocate 12.5 MHz in the 908.75 - 921.25 band for the use of Radar Wind Profilers, and adopt the rules set forth in Radian's December 18, 1992 Erratum.

Respectfully submitted,

Radian Corporation

James E. Dunstan

Susan H. Rosenau

HALEY, BADER & POTTS
Suite 900
4350 North Fairfax Drive
Arlington, VA 22203-1633
703/841-0606

June 15, 1993

Exhibit 1

SUPPLEMENTAL ENGINEERING STATEMENT OF JOHN NEUSCHAEFER

John Neuschaefer, under penalty of perjury, states as follows:

1. I am a Staff Engineer at Radian Corporation ("Radian"). My qualifications, employment history, duties and expertise in the area of Wind Profilers are described in full in the Engineering Statement submitted in support of Radian's Reply Comments as Appendix A thereto.

2. I have reviewed the Comments Radian has prepared in response to the Notice of Inquiry issued by the Federal Communications Commission on April 1, 1993 (FCC Document 93-136), and to the best of my knowledge and belief, the statements contained therein are true and correct.

3. Wind Profilers operating and 449 MHz and Wind Profilers operating at 915 MHz serve distinct important functions. Wind Profilers operating at 449 MHz are highly suitable for National Weather Service

5. The demand for 915 MHz Wind Profilers for environmental uses is growing. Radian continues to receive orders for 915 MHz Wind Profilers at a rate exceeding one per month, virtually all of which are to be used in air-quality and atmospheric pollution studies.

6. The environmental projects for which high-frequency Wind Profilers are so exclusively suited often require high precision and range resolution, which is a function of both pulse duration and, therefore, occupied bandwidth. The Wind Profiler operating at 915 MHz requires additional occupied bandwidth because it is intended to make measurements having finer range resolution than the 449 MHz wind profiler. The radar range resolution is determined by the duration of the transmitted pulse (~150 meters/μS). The Wind Profiler Network Profilers (ata 404.37 MHz) have a minimum range resolution of ~380 meters (~ 2.55 μS pulse). A similar system is envisioned for 449 MHz. the 915 MHz profiler uses a minimum range resolution of 60 meters (0.4 μS pulse). The difference in occupied bandwidth required for the two frequencies (449 vs. 915 MHz) is created by the difference in pulse duration. In Radian's judgment, the lower frequencies such as 449 MHz are simply too crowded to accommodate the bandwidth required for environmental uses of Wind Profilers.

Signed under penalty of perjury this 15 day of June, 1993.

John M[illegible]schaefer

Exhibit 2

South Coast
AIR QUALITY MANAGEMENT DISTRICT
21865 E. Copley Drive, Diamond Bar, CA 91765-4182 (909) 396-2000

May 4, 1993

Mr. Carl Huie
Federal Communications Commission
Office of Engineering and Technology
1919 M Street, NW
Washington, D.C. 20554

Dear Mr Huie, Re: Notice of Inquiry FCC 93-136

The South Coast Air Quality Management District (District) has recently completed a 5-month field demonstration of the Radian/STI 915 Mhz radar wind profiler and radio acoustic sounding system (RASS) at Los Angeles International Airport. The profiler and RASS system, operating at the 915 Mhz frequency, accurately provided data characterizing the structure of the lower tropospheric winds and temperature over the coastal Los Angeles area. The reliability of the system, and its minimum requirements for continuous operation have made the 915 Mhz profiler and RASS an attractive, cost effective alternative to our current daily airsonde program. The District believes that the 915 Mhz wind profiler and RASS system will provide the data needed to accurately forecast daily air quality, and enhance the ability to model regional air pollution as a function of the development of our strategic plan to clean the air in the South Coast Air Basin. This will enable us to better address our federal mandate to clean the air in the Los Angeles area.

The District is evaluating the possibility of either purchasing or entering into a multiple year leasing agreement for one or more of these systems. The utility of these systems has been discussed with the California Air Resources Board and the local National Weather Service Forecast and Federal Aviation Administration offices. A potential network of these profilers could provide a shared data base that would enhance weather and aviation forecasting activities throughout Southern California. Consequently, the District strongly recommends that the Federal Communications Commission, (in reference to Notice of Inquiry FCC 93-136), allocate the 915 Mhz frequency to the wind and temperature profilers on a permanent basis.

We will be glad to share the results of our profiler demonstration project with you. Please contact Mr. Joseph Cassmassi, Senior Meteorologist at (909) 396-3155 if you have any questions regarding this matter. We look forward to your decision.

Sincerely,

Alan Lloyd

Alan C. Lloyd, Ph.D.
Chief Scientist

BRW:HH:JCC

cc: Donald Blumenthal, Ph.D.

Exhibit 3

NCAR

Office of the Director
National Center for Atmospheric Research
P.O. Box 3000, Boulder, CO 80307-3000
Tel: (303) 497-1111

Robert J. Serafin

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June 2, 1993

Russ Peterman/Rodian
FYI!

Mr. Carl Hine
Federal Communications Commission
1919 M Street NW
Washington, DC 20554

Re: FCC Notice of Inquiry DC-2358 ET Docket 93-59

Dear Mr. Hine:

The National Center for Atmospheric Research (NCAR) currently operates four 915 MHz wind profilers. Each wind profiler is a crucial part of NCAR's Integrated Sounding System (ISS) which combines various state-of-the-art remote and *in situ* sensors into single transportable units. NCAR plans to eventually have 8-10 ISS.

The current ISS/wind profiling systems serve two primary functions. One system is dedicated to climate studies and the other three systems primarily serve the research needs of the university atmospheric and ocean science communities. These systems are deployed throughout the U.S. and abroad. The data from the ISS/wind profilers is used to study many research topics of national importance, including climate change, cloud-climate interactions, data assimilation (the incorporation of data into numerical prediction models), boundary layer meteorology and mesoscale processes (including severe weather prediction). The ability of the [redacted]

Exhibit 4

KRP

The Pennsylvania State University
College of Earth and Mineral Sciences
Inter-office Correspondence

Date: 27 May 1993

From: Dennis W. Thomson, Professor and Head

To: Whom It May Concern

Subject: Operation of Doppler radar wind profilers at about 915 MHz

The Department of Meteorology at Penn State University is one of several academic programs that has built and operated wind profilers for a variety of research and teaching applications. Specifically, since 1985 we have operated three different 50 MHz systems, one 404 MHz and one 915 MHz. Since each system (and its operating frequency) is optimally suited for different phenomenological studies, the radars have been used at different locations and times to support more than 25 specific student and faculty research projects. The topics of individual studies have ranged from cloud microphysics and severe storms to stratospheric dynamics and clear air turbulence.

Wind profiling radars are today the only electronic systems capable of providing essential meteorological wind and turbulence measurements on the time and space scales which are required to support modern atmospheric analysis and forecast models. These models are generally considered today to be observationally limited, that is unless input data such as that from profilers can be provided, little improvement in, e.g., forecast quality can be expected. In the case of severe storm applications, this is essentially an issue of life or death for potentially impacted citizens. Even in cases as apparently esoteric as improvement of climate models, profiler-type measurements provide the essential data necessary to establish the credibility

Thus, we hereby request that the FCC allocate and protect a frequency band extending from about 909 to 921 MHz for wind profiler operation. A lesser bandwidth would seriously compromise system operations for measurements of winds and turbulence in the lower atmosphere. For most of our research applications operation on a shared spectrum basis can be accommodated. Most of the transmitted energy from a profiler is directed nearly vertically and the same shielding which is used to inhibit sidelobes will protect the receiver from other possible local ground-based transmitters.

To the extent that wind profilers can and do provide essential information on hazardous and life threatening weather phenomena, e.g., clear air turbulence and severe storms, use of the above frequency band for profilers rather than AVM devices is strongly recommended. In our view the latter are merely a matter of business convenience rather than necessity. Furthermore because AVM operations involve mobile transmitters it represents an application which can potentially preclude or interfere with any other system at any location in the proximity of a road.

Finally, there are many nongovernmental wind profiler applications, e.g., for wind and turbulence measurements in the vicinity of nuclear reactors or hazardous chemical manufacturing facilities. It has been shown that wind profilers can provide the backbone environmental data required for operation of an emergency response system. Thus, we request that licensing not be restricted to any particular group(s).

cc: J.P. Breen, Penn State